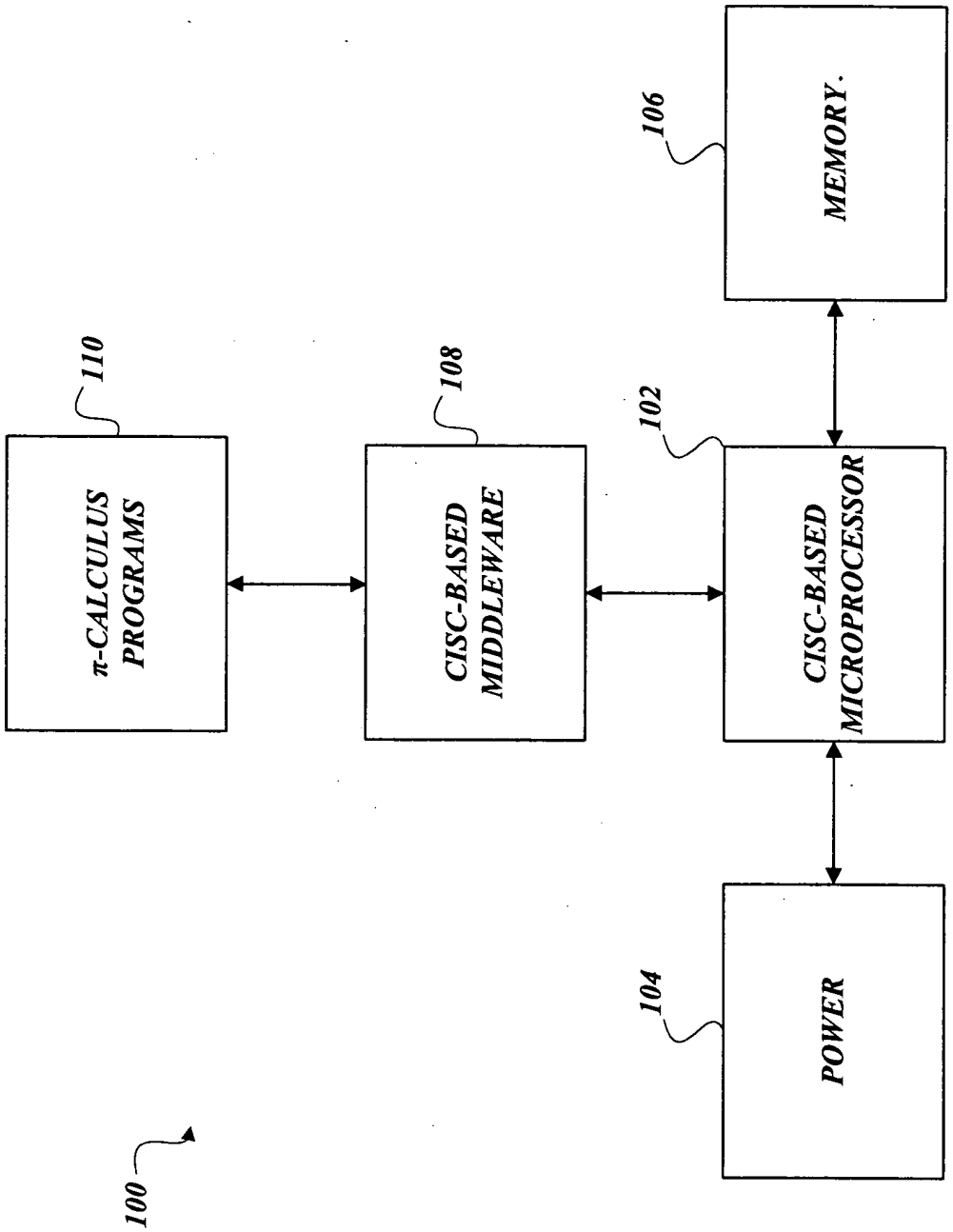

100
π-CALCULUS PROGRAMS
110
CISC-BASED MIDDLEWARE
108
CISC-BASED MICROPROCESSOR
102
MEMORY
106
POWER
104

Fig. 1.

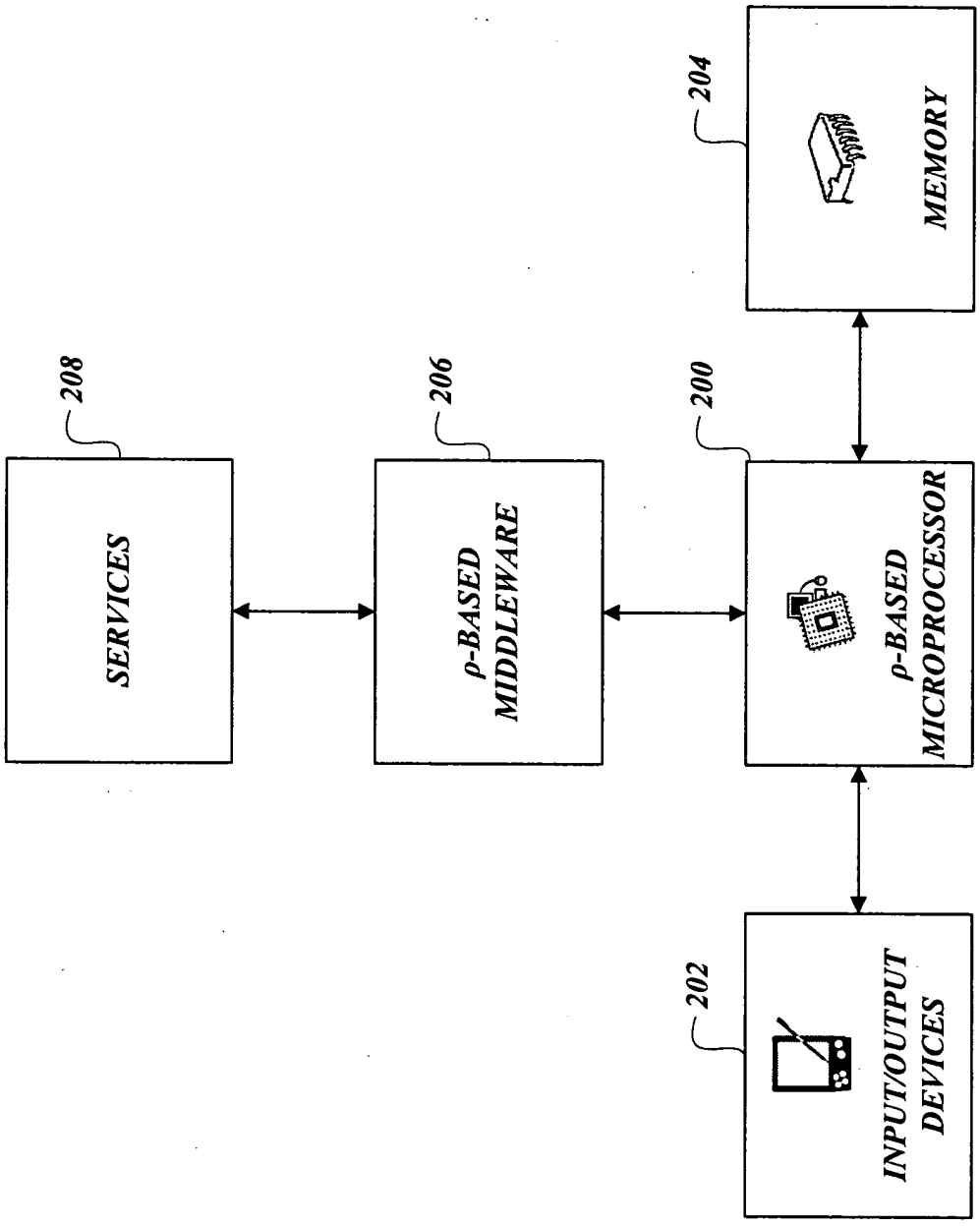

204
MEMORY
208
206
200
SERVICES
ρ-BASED MIDDLEWARE
ρ-BASED MICROPROCESSOR
202
INPUT/OUTPUT DEVICES

Fig.2A.

Fig.2B.

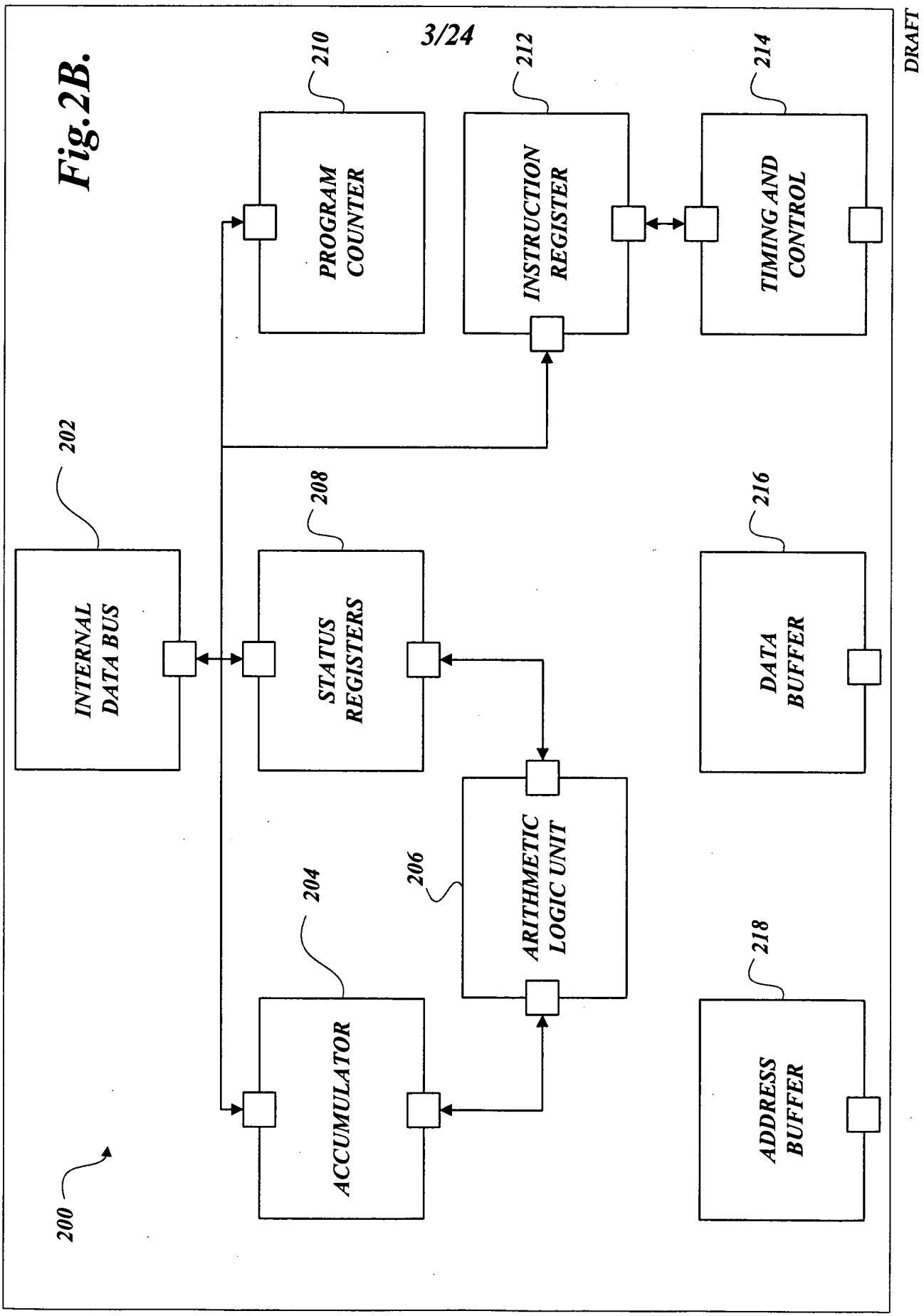
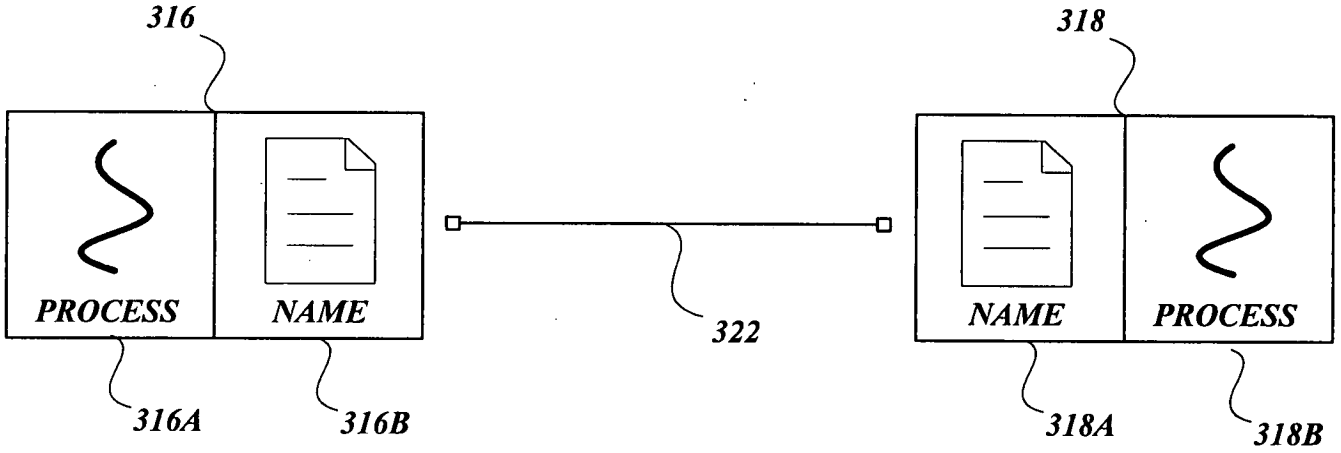

200
202
INTERNAL DATA BUS
204
ACCUMULATOR
206
ARITHMETIC LOGIC UNIT
208
STATUS REGISTERS
210
PROGRAM COUNTER
212
INSTRUCTION REGISTER
214
TIMING AND CONTROL
216
DATA BUFFER
218
ADDRESS BUFFER

Fig.3B.



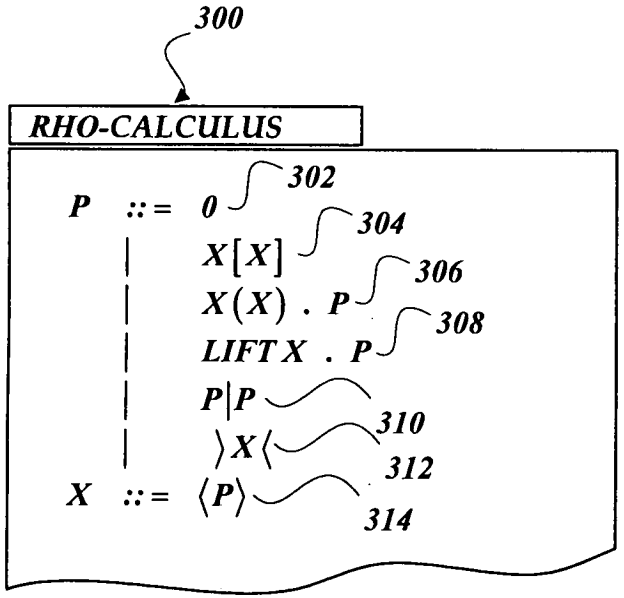
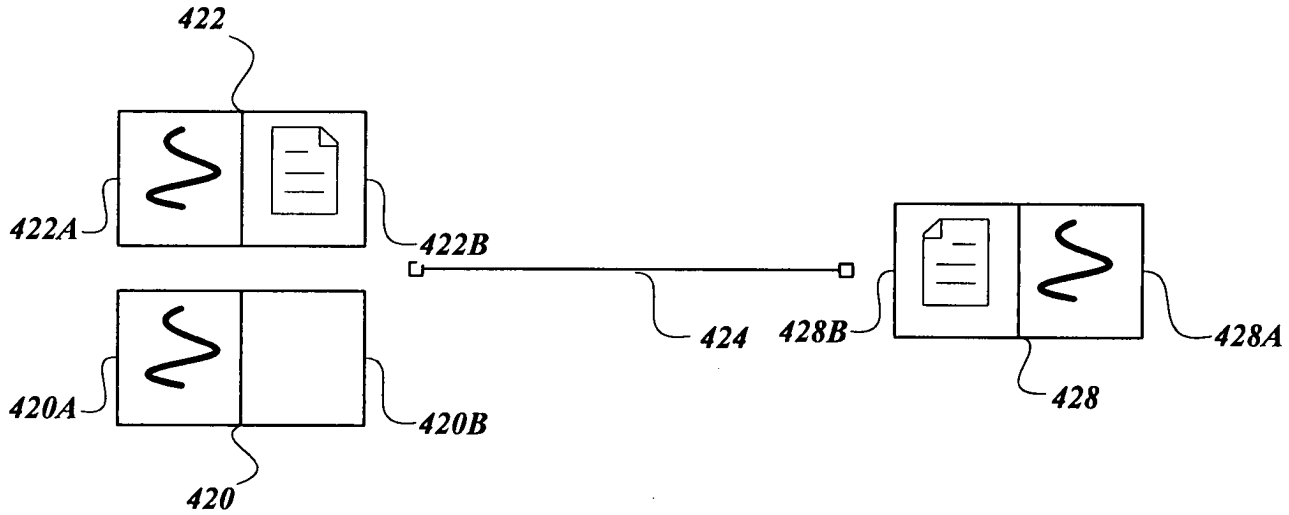


Fig.3A.

Title: PROCESS LANGUAGE FOR MICROPROCESSORS WITH FINITE RESOURCES
Inventors: L. Greg Meredith et al.
Docket No.: MSFT122259

Title: PROCESS LANGUAGE FOR MICROPROCESSORS WITH FINITE RESOURCES
Inventors: L. Greg Meredith et al.
Docket No.: MSFT122259

Fig.4B.



400

TYPED PROCESSES IN RHO-CALCULUS

		0	402
P	::=	X[Y]	404
	|	X(Z) . P	406
	|	LIFT X . P	408
	|	P|P	
	|	⟩X⟨	410
X	::=	⟨P⟩	412
Y	::=	⟨P⟩,P:T	414
Z	::=	⟨P⟩,P:U	416
			418

Fig.4A.

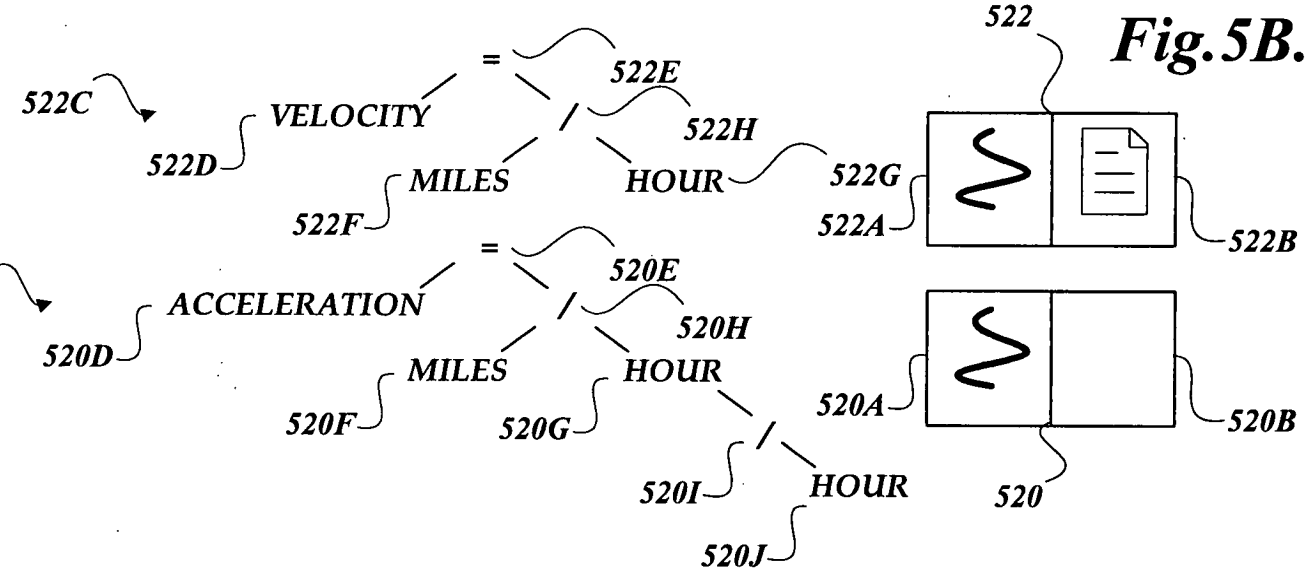


Fig.5B.

500

MACHINE CALCULUS

		502	
P	::=	0	504
	|	X[Y]	506
	|	X(Z) . P	508
	|	LIFT X . P	
	|	P|P	510
	|	⟩X⟨	512
X	::=	⟨P⟩,#(P) ≤ K	514
Y	::=	⟨P⟩,P:T	516
Z	::=	⟨P⟩,P:U	518

Fig.5A.

6/24

Title: PROCESS LANGUAGE FOR MICROPROCESSORS WITH FINITE RESOURCES
Inventors: L. Greg Meredith et al.
Docket No.: MSFT122259

Title: PROCESS LANGUAGE FOR MICROPROCESSORS WITH FINITE RESOURCES
Inventors: L. Greg Meredith et al.
Docket No.: MSFT122259

Fig. 6A.

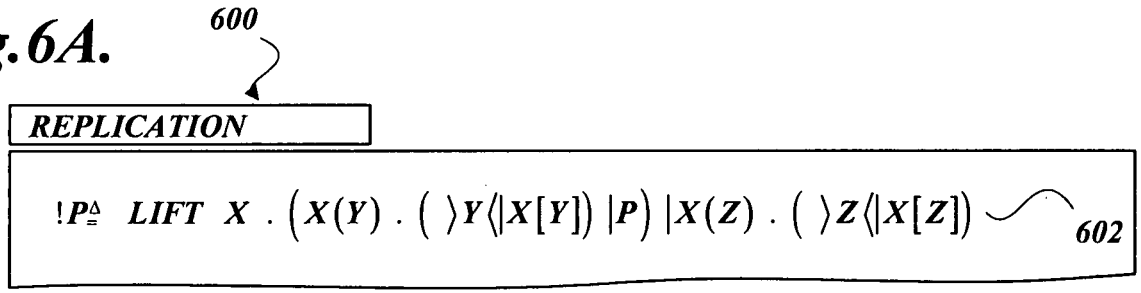


Fig. 6B.

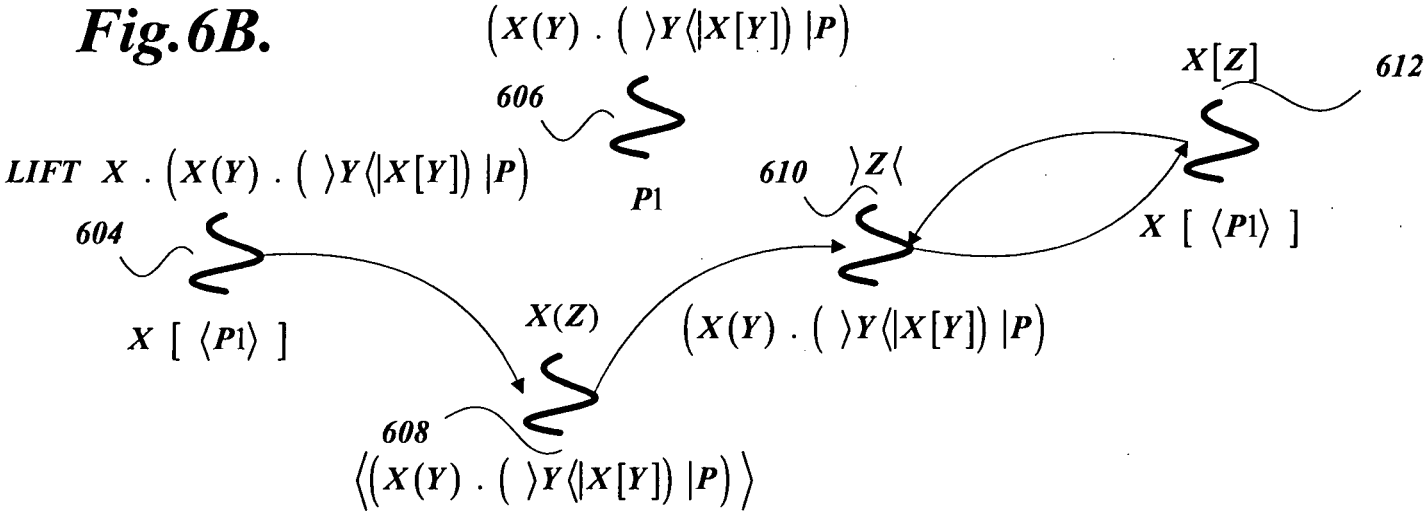


Fig. 7A.

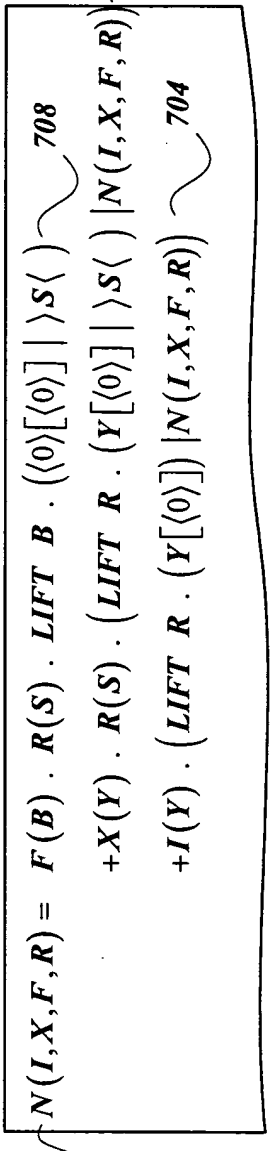
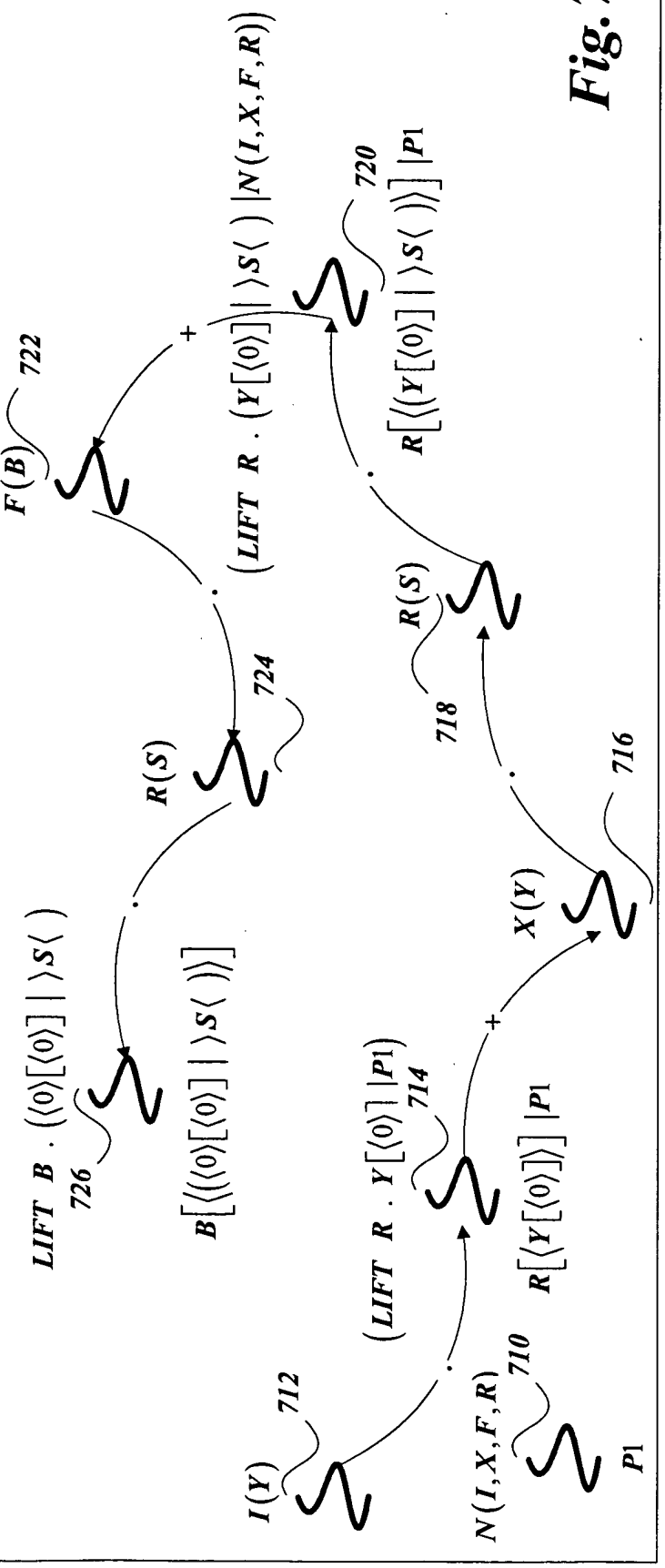

700
NAME SERVICE
N(I,X,F,R) = F(B) . R(S) . LIFT B . (⟨0⟩[⟨0⟩] | ⟩S⟨)
+X(Y) . R(S) . (LIFT R . (Y[⟨0⟩] | ⟩S⟨) |N(I,X,F,R))
+I(Y) . (LIFT R . (Y[⟨0⟩]) |N(I,X,F,R))
702
704
706
708

Fig. 7B.


F(B)
722
LIFT B . (⟨0⟩[⟨0⟩] | ⟩S⟨)
726
B[⟨(⟨0⟩[⟨0⟩] | ⟩S⟨)⟩]
R(S)
724
(LIFT R . (Y[⟨0⟩] | ⟩S⟨) |N(I,X,F,R))
720
R[⟨(Y[⟨0⟩] | ⟩S⟨)⟩] |P1
R(S)
718
X(Y)
716
I(Y)
712
(LIFT R . Y[⟨0⟩] |P1)
714
N(I,X,F,R)
710
R[⟨Y[⟨0⟩]⟩] |P1
P1

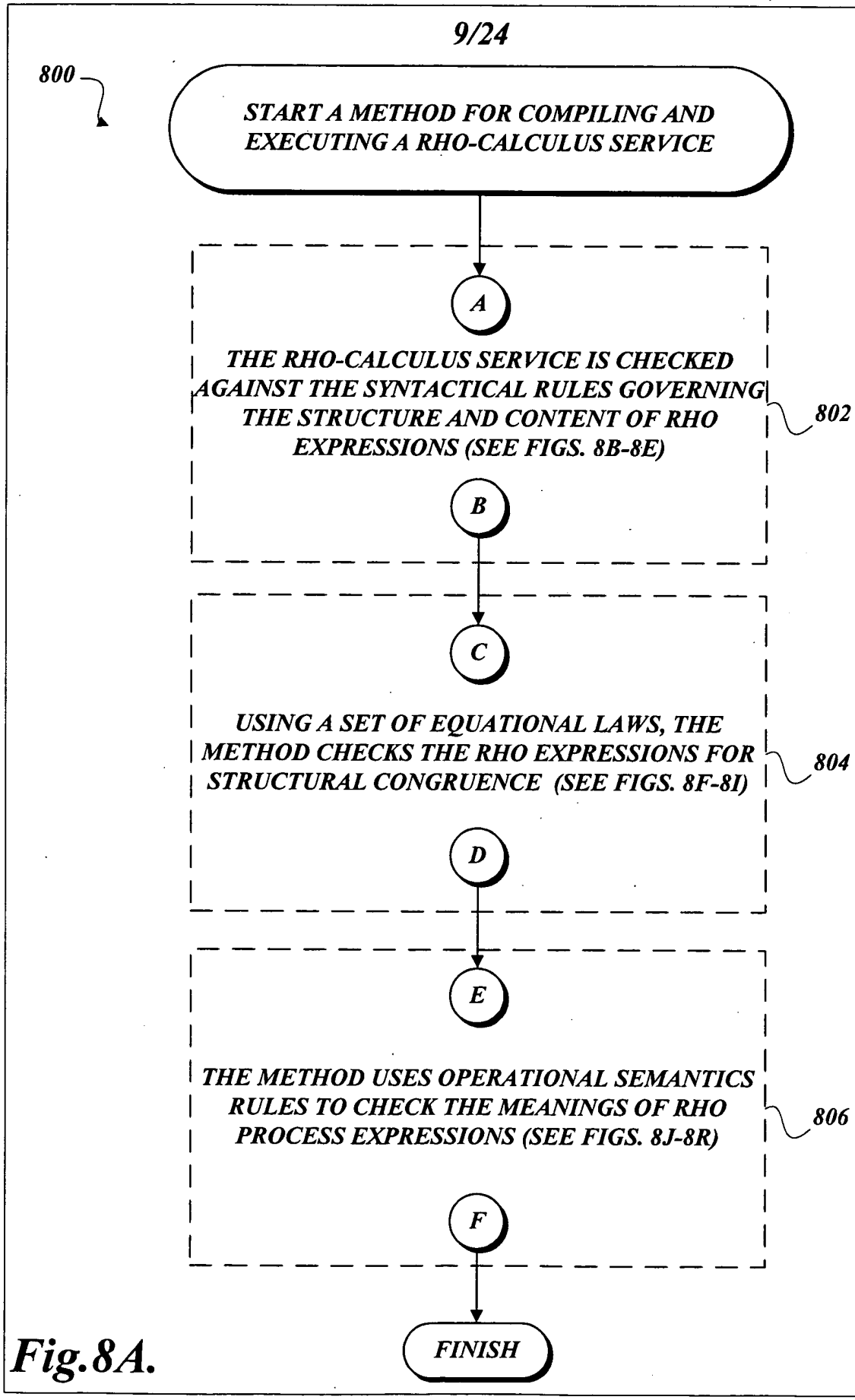

800
START A METHOD FOR COMPILING AND EXECUTING A RHO-CALCULUS SERVICE
A
THE RHO-CALCULUS SERVICE IS CHECKED AGAINST THE SYNTACTICAL RULES GOVERNING THE STRUCTURE AND CONTENT OF RHO EXPRESSIONS (SEE FIGS. 8B-8E)
802
B
C
USING A SET OF EQUATIONAL LAWS, THE METHOD CHECKS THE RHO EXPRESSIONS FOR STRUCTURAL CONGRUENCE (SEE FIGS. 8F-8I)
804
D
E
THE METHOD USES OPERATIONAL SEMANTICS RULES TO CHECK THE MEANINGS OF RHO PROCESS EXPRESSIONS (SEE FIGS. 8J-8R)
806
F
FINISH

Fig.8A.

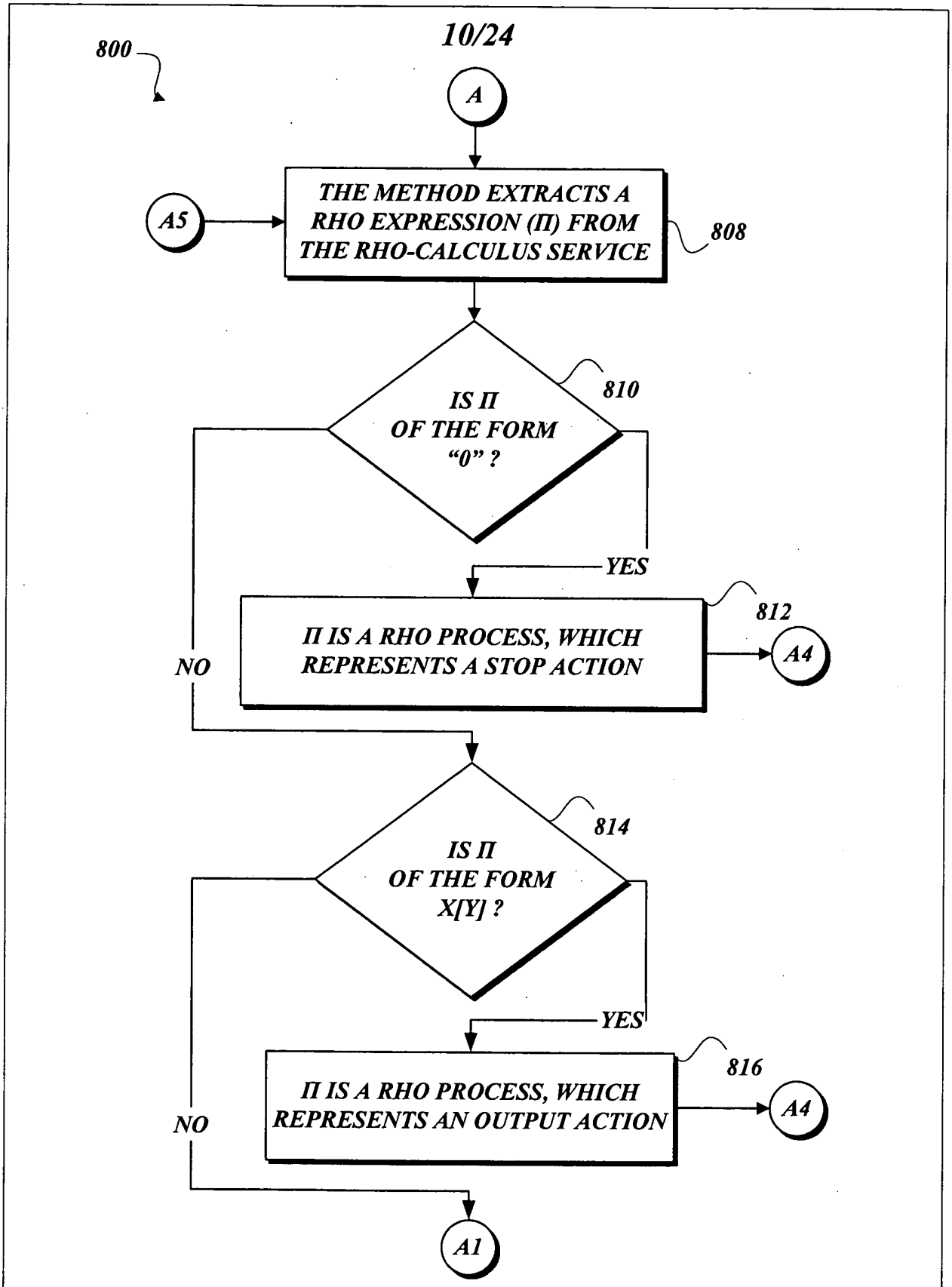

800
A
A5
THE METHOD EXTRACTS A RHO EXPRESSION (Π) FROM THE RHO-CALCULUS SERVICE
808
IS Π OF THE FORM "0" ?
810
YES
NO
Π IS A RHO PROCESS, WHICH REPRESENTS A STOP ACTION
812
A4
IS Π OF THE FORM X[Y] ?
814
YES
NO
Π IS A RHO PROCESS, WHICH REPRESENTS AN OUTPUT ACTION
816
A4
A1

Fig.8B.

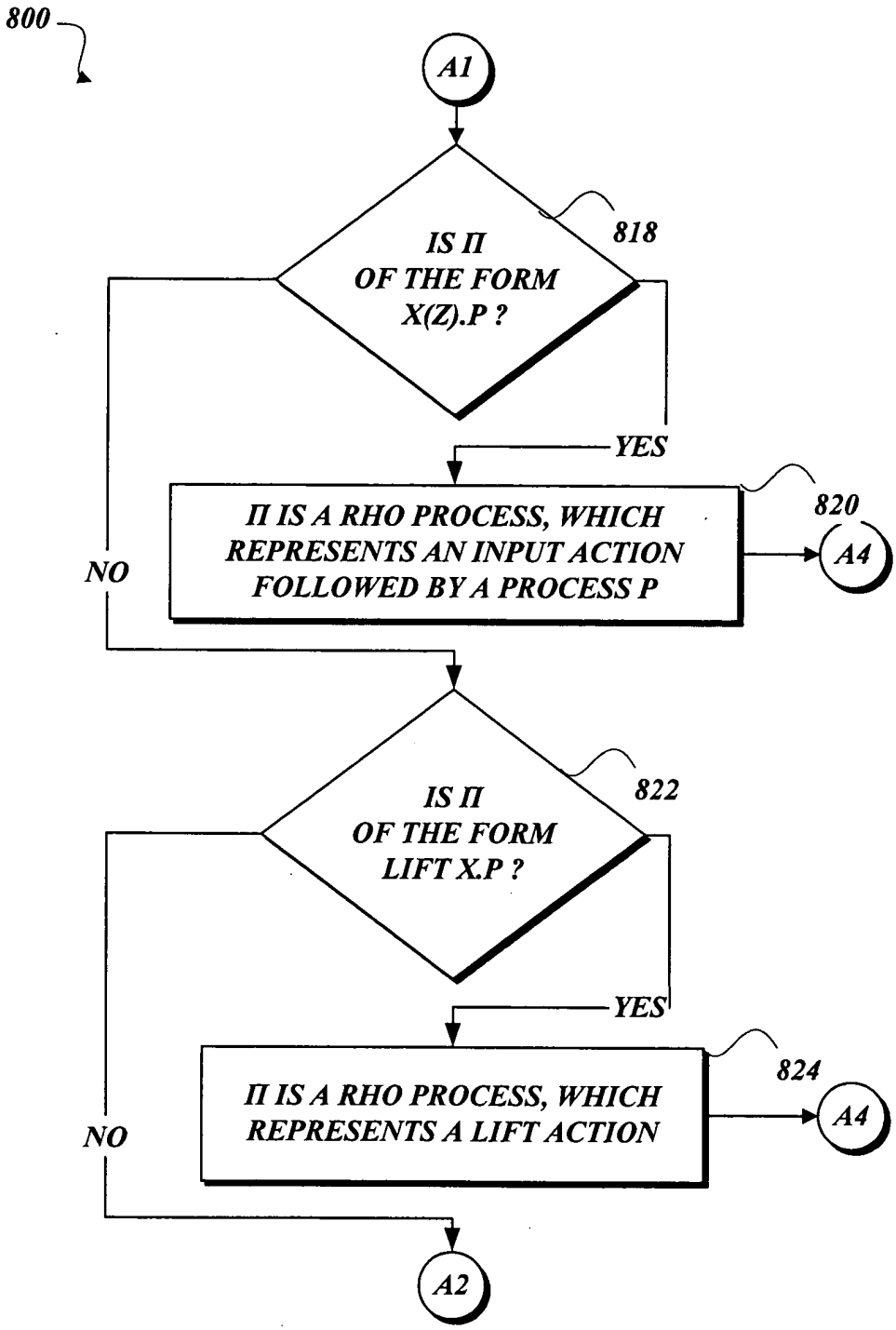

800
A1
IS Π OF THE FORM X(Z).P ?
818
YES
Π IS A RHO PROCESS, WHICH REPRESENTS AN INPUT ACTION FOLLOWED BY A PROCESS P
820
A4
NO
IS Π OF THE FORM LIFT X.P ?
822
YES
Π IS A RHO PROCESS, WHICH REPRESENTS A LIFT ACTION
824
A4
NO
A2

Fig.8C.

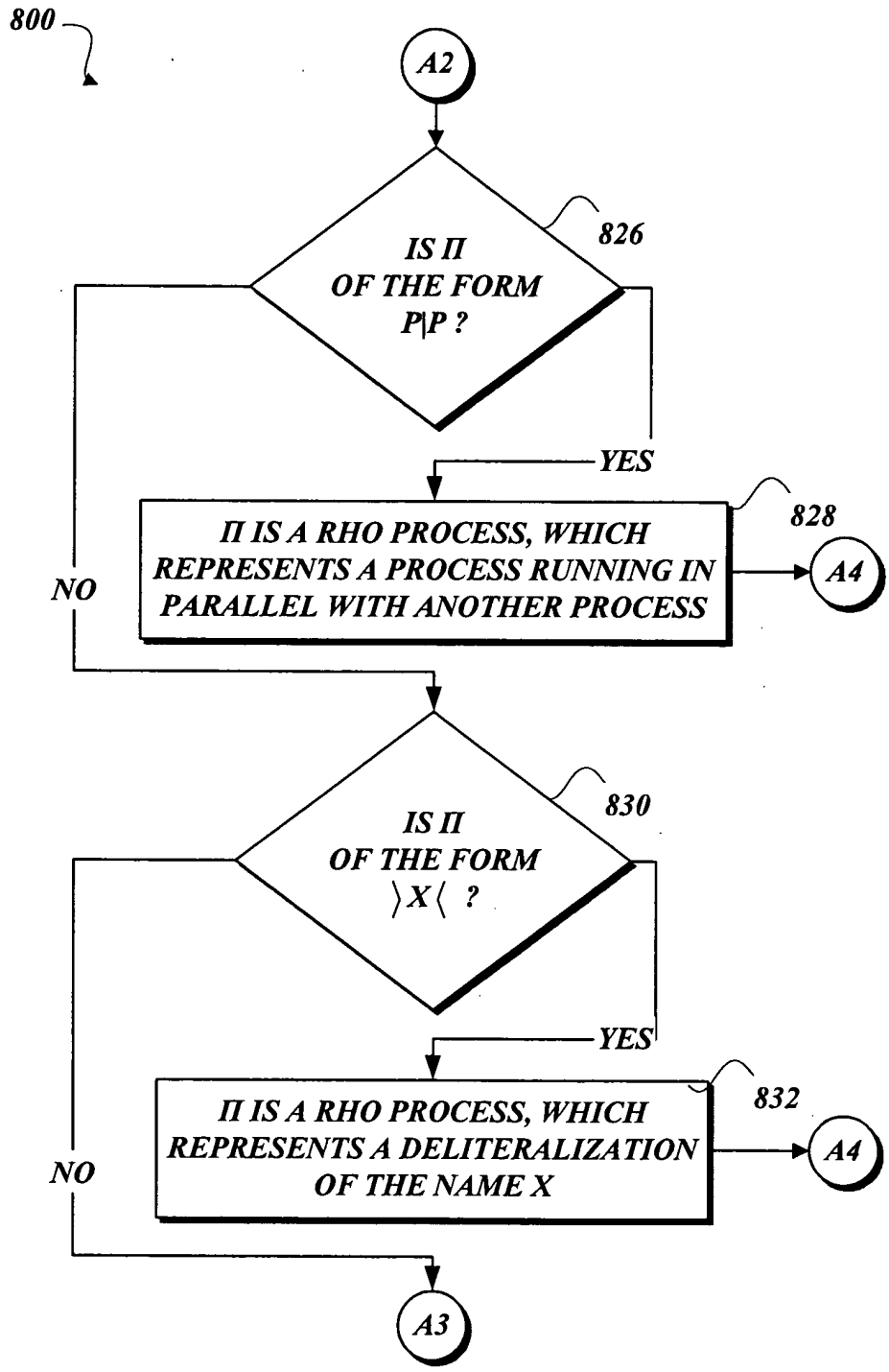
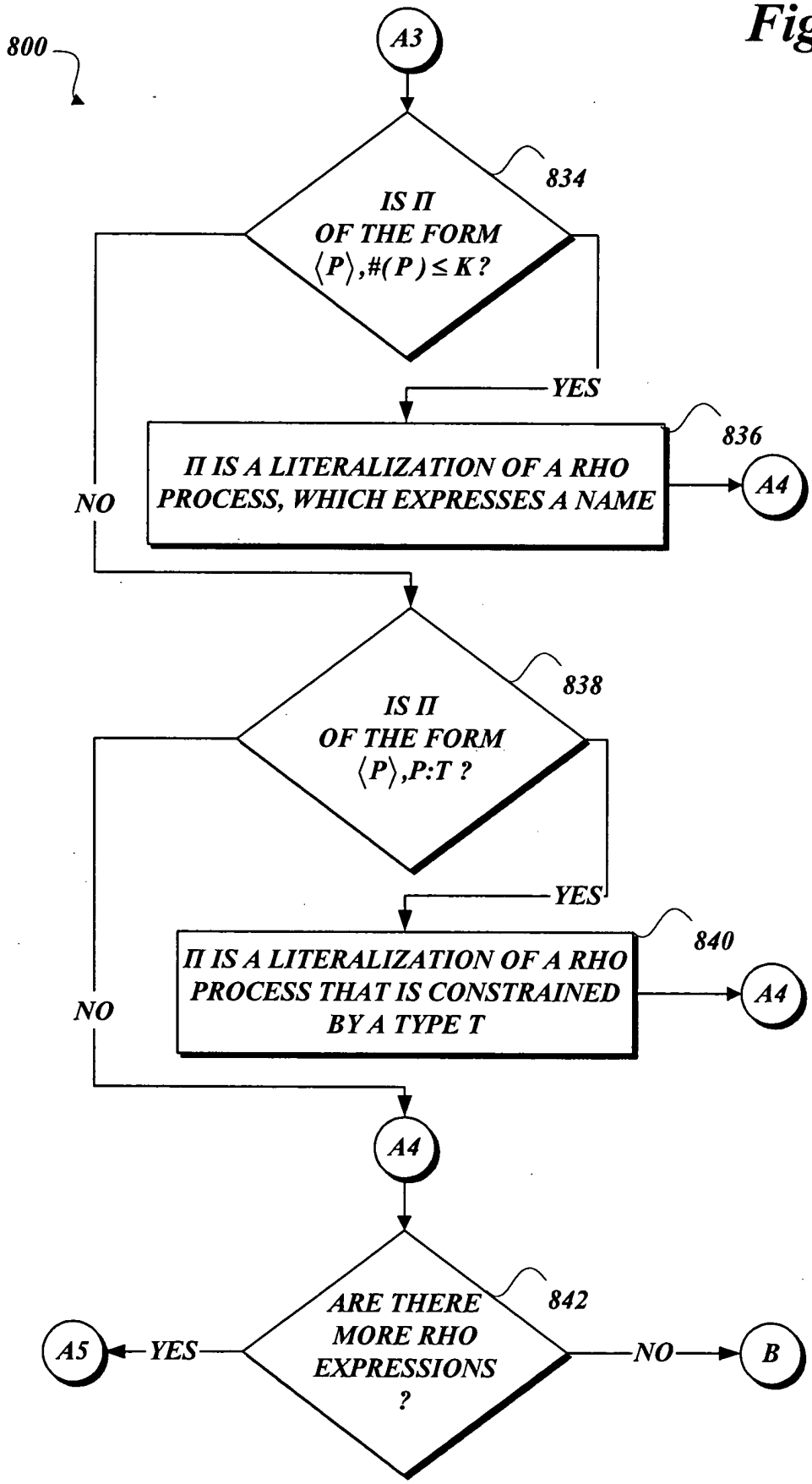

800
A2
IS Π
OF THE FORM
P|P ?
826
YES
Π IS A RHO PROCESS, WHICH
REPRESENTS A PROCESS RUNNING IN
PARALLEL WITH ANOTHER PROCESS
828
A4
NO
IS Π
OF THE FORM
⟩X⟨ ?
830
YES
Π IS A RHO PROCESS, WHICH
REPRESENTS A DELITERALIZATION
OF THE NAME X
832
A4
NO
A3

Fig.8D.

Fig.8E.


800
A3
834
IS Π OF THE FORM ⟨P⟩,#(P) ≤ K?
YES
836
Π IS A LITERALIZATION OF A RHO PROCESS, WHICH EXPRESSES A NAME
A4
NO
838
IS Π OF THE FORM ⟨P⟩,P:T ?
YES
840
Π IS A LITERALIZATION OF A RHO PROCESS THAT IS CONSTRAINED BY A TYPE T
A4
NO
A4
842
ARE THERE MORE RHO EXPRESSIONS ?
A5
YES
NO
B

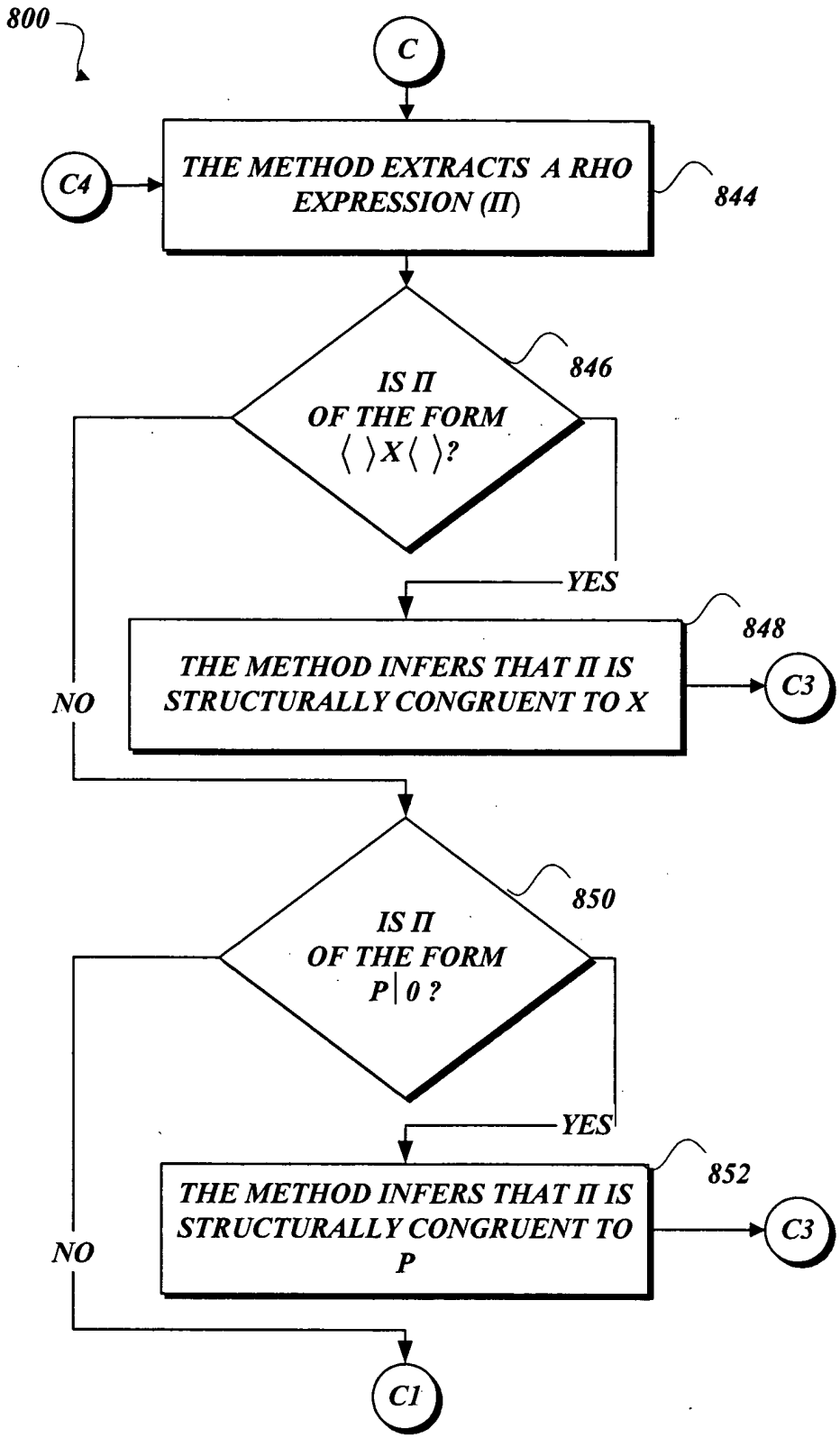

800
C
C4
THE METHOD EXTRACTS A RHO EXPRESSION (Π)
844
IS Π OF THE FORM ⟨ ⟩X⟨ ⟩?
846
YES
NO
THE METHOD INFERS THAT Π IS STRUCTURALLY CONGRUENT TO X
848
C3
IS Π OF THE FORM P | 0 ?
850
YES
NO
THE METHOD INFERS THAT Π IS STRUCTURALLY CONGRUENT TO P
852
C3
C1

Fig.8F.

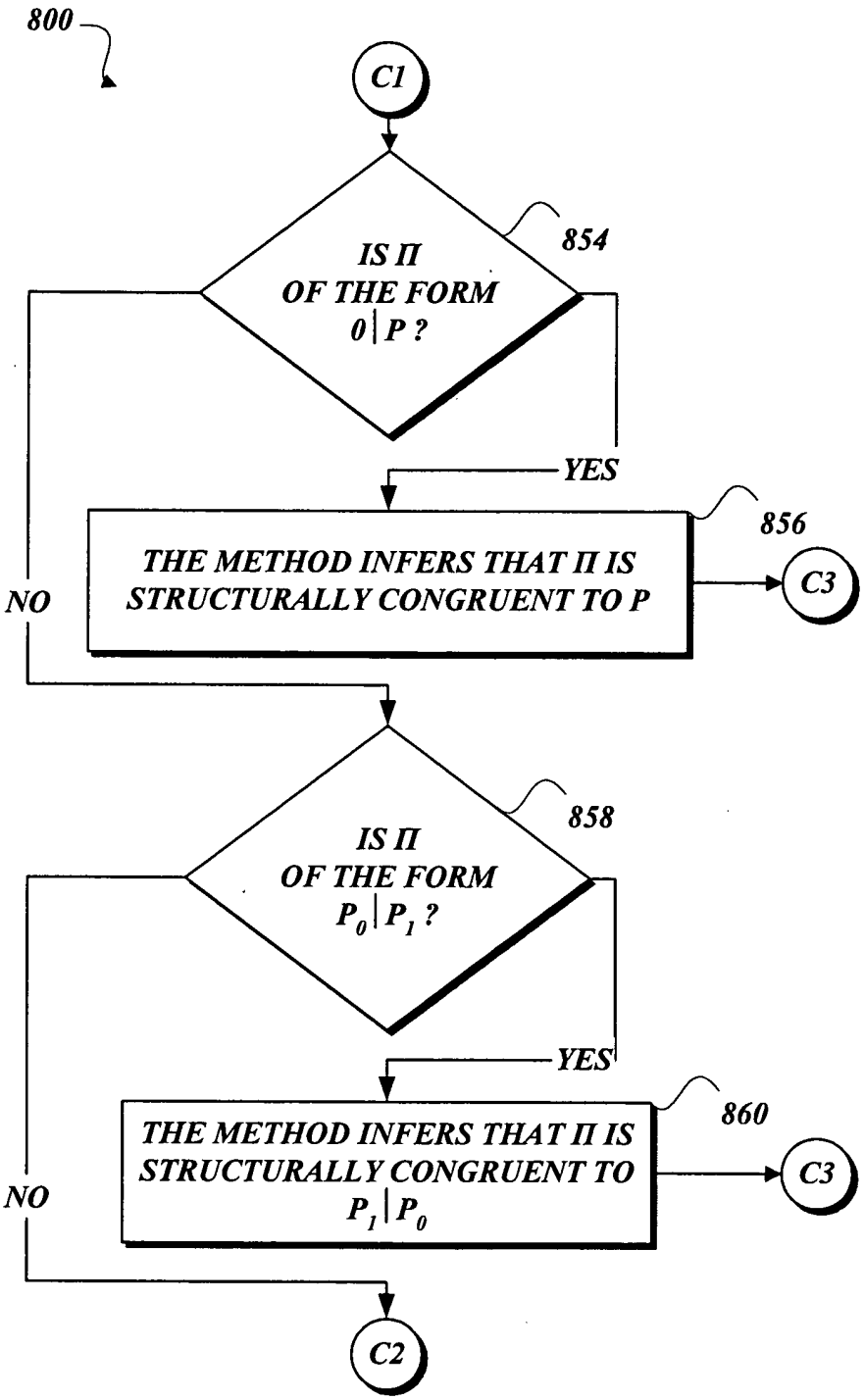
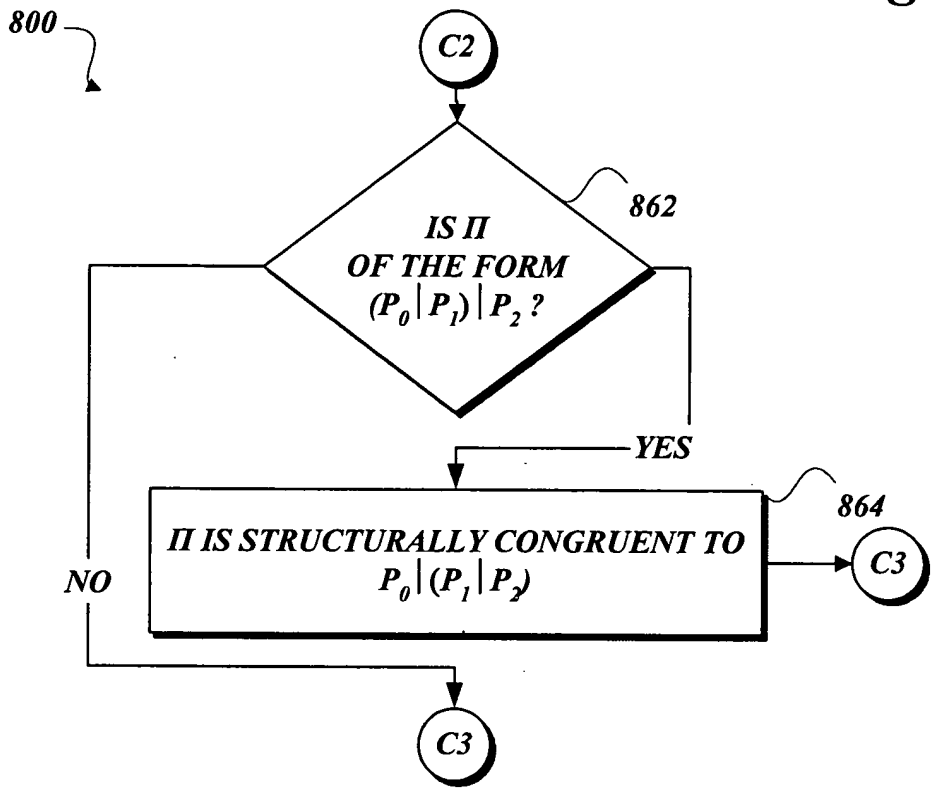

800
C1
IS Π OF THE FORM 0 | P ?
854
YES
NO
THE METHOD INFERS THAT Π IS STRUCTURALLY CONGRUENT TO P
856
C3
IS Π OF THE FORM P0 | P1 ?
858
YES
NO
THE METHOD INFERS THAT Π IS STRUCTURALLY CONGRUENT TO P1 | P0
860
C3
C2

Fig.8G.

Fig.8H.


800
C2
862
IS Π
OF THE FORM
$(P_0 | P_1) | P_2$?
YES
NO
864
Π IS STRUCTURALLY CONGRUENT TO
$P_0 | (P_1 | P_2)$
C3
C3

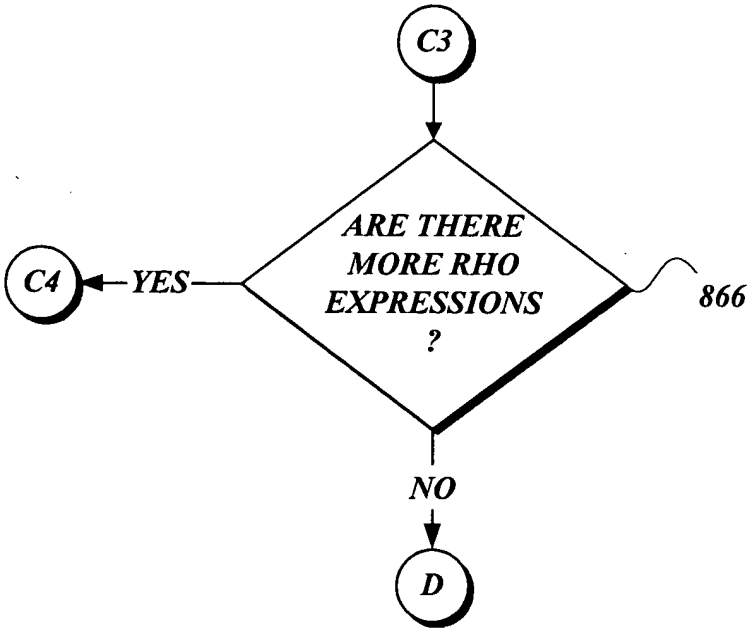
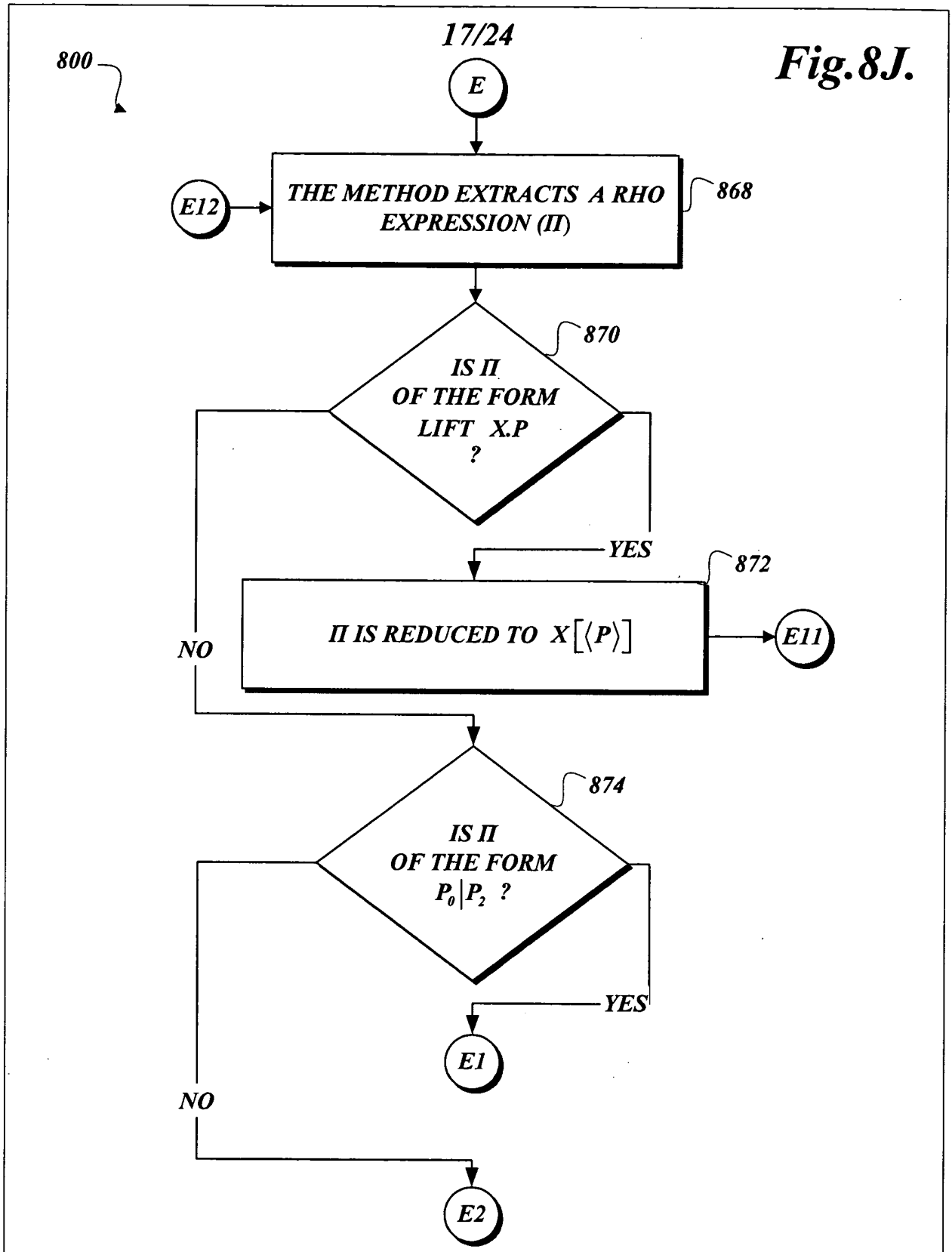

C3
ARE THERE
MORE RHO
EXPRESSIONS
?
C4
YES
866
NO
D

Fig.8I.

Fig.8J.


800
E
E12
THE METHOD EXTRACTS A RHO EXPRESSION (Π)
868
870
IS Π OF THE FORM LIFT X.P ?
YES
872
Π IS REDUCED TO X[⟨P⟩]
E11
NO
874
IS Π OF THE FORM P0|P2 ?
YES
E1
NO
E2

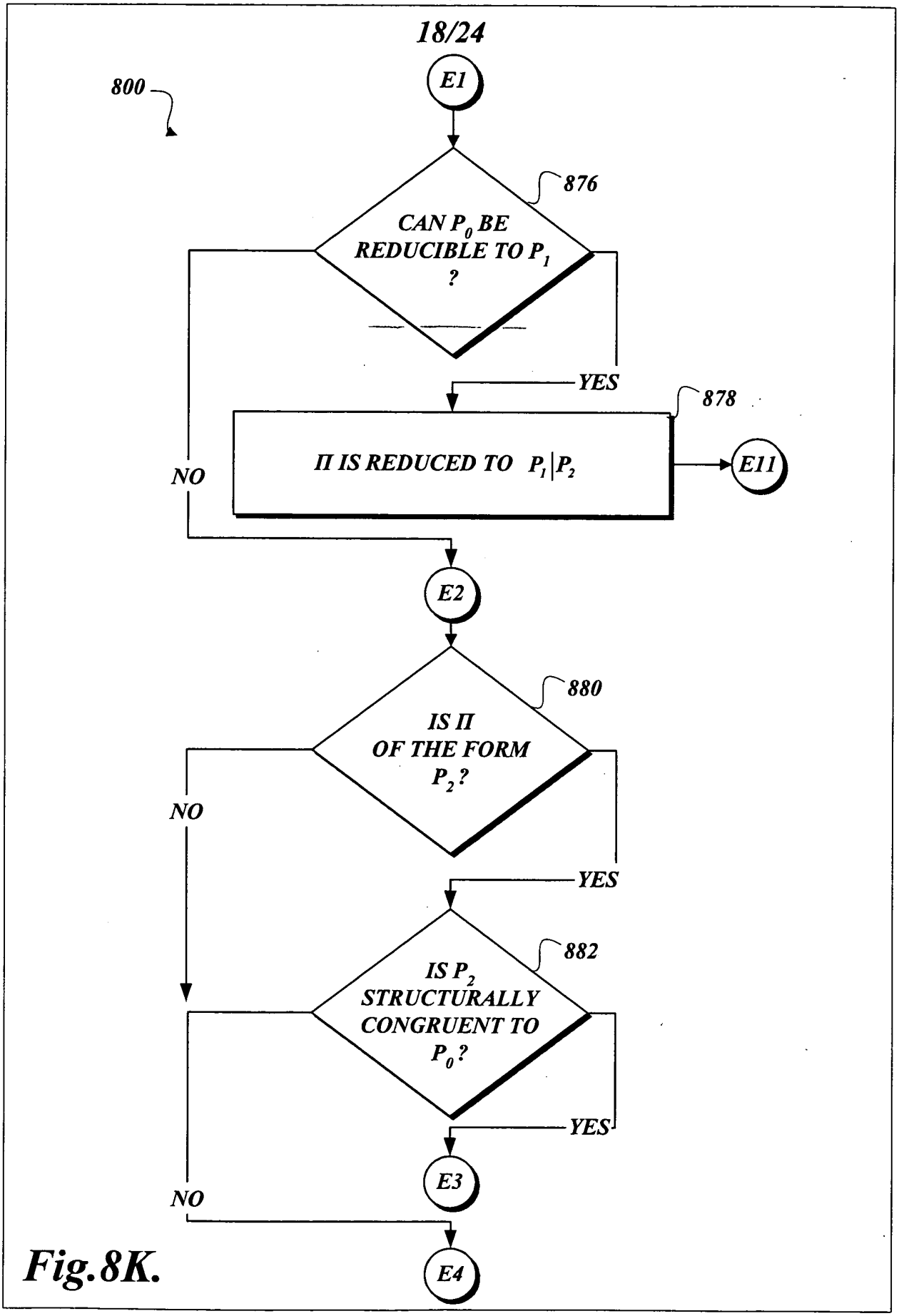

800
E1
876
CAN P_0 BE REDUCIBLE TO P_1 ?
YES
878
Π IS REDUCED TO $P_1|P_2$
E11
NO
E2
880
IS Π OF THE FORM P_2?
NO
YES
882
IS P_2 STRUCTURALLY CONGRUENT TO P_0?
YES
E3
NO
E4

Fig.8K.

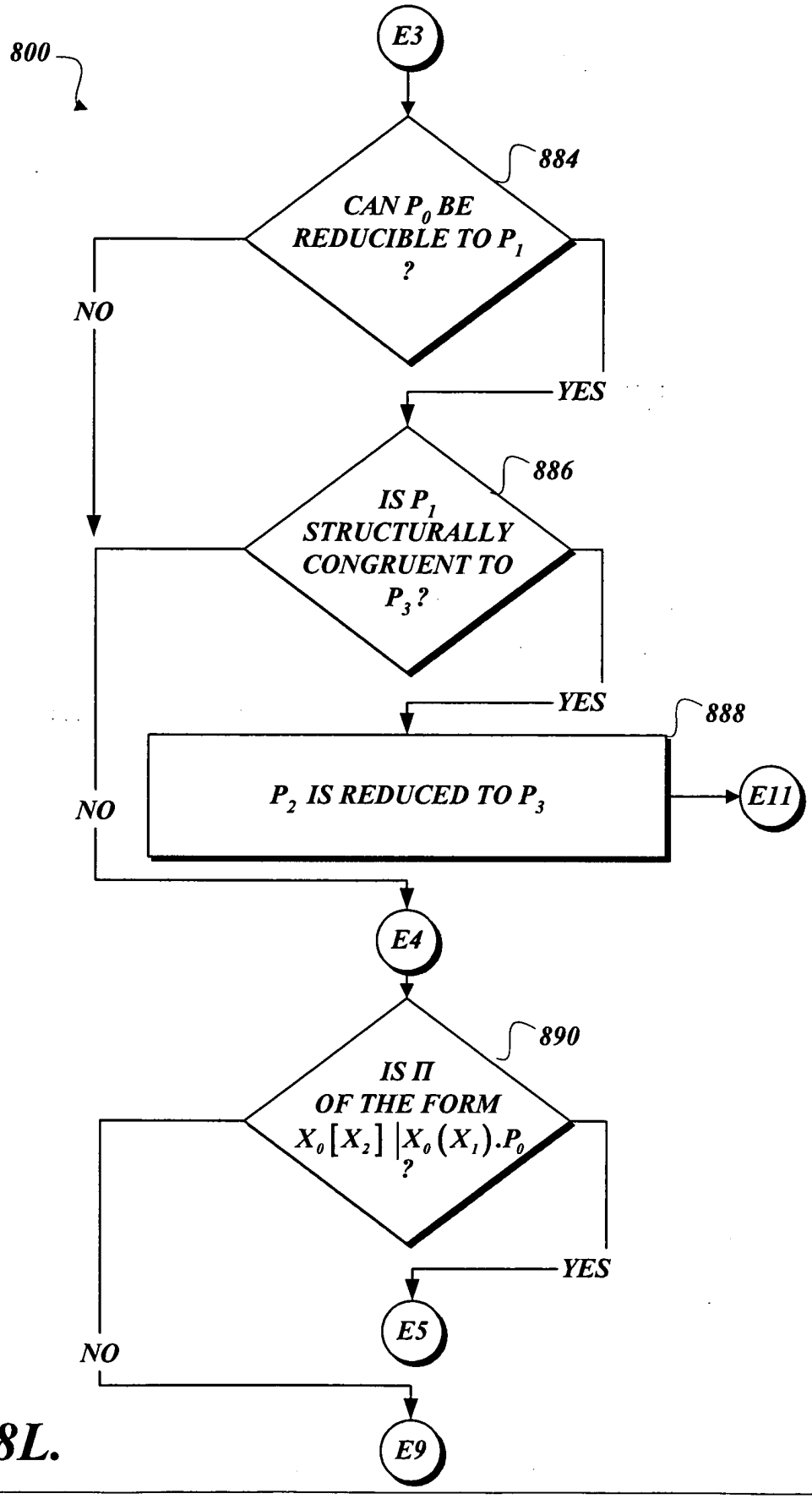

800
E3
884
CAN P_0 BE REDUCIBLE TO P_1 ?
NO
YES
886
IS P_1 STRUCTURALLY CONGRUENT TO P_3 ?
YES
888
NO
P_2 IS REDUCED TO P_3
E11
E4
890
IS Π OF THE FORM $X_0[X_2] \mid X_0(X_1).P_0$?
YES
E5
NO
E9

Fig.8L.

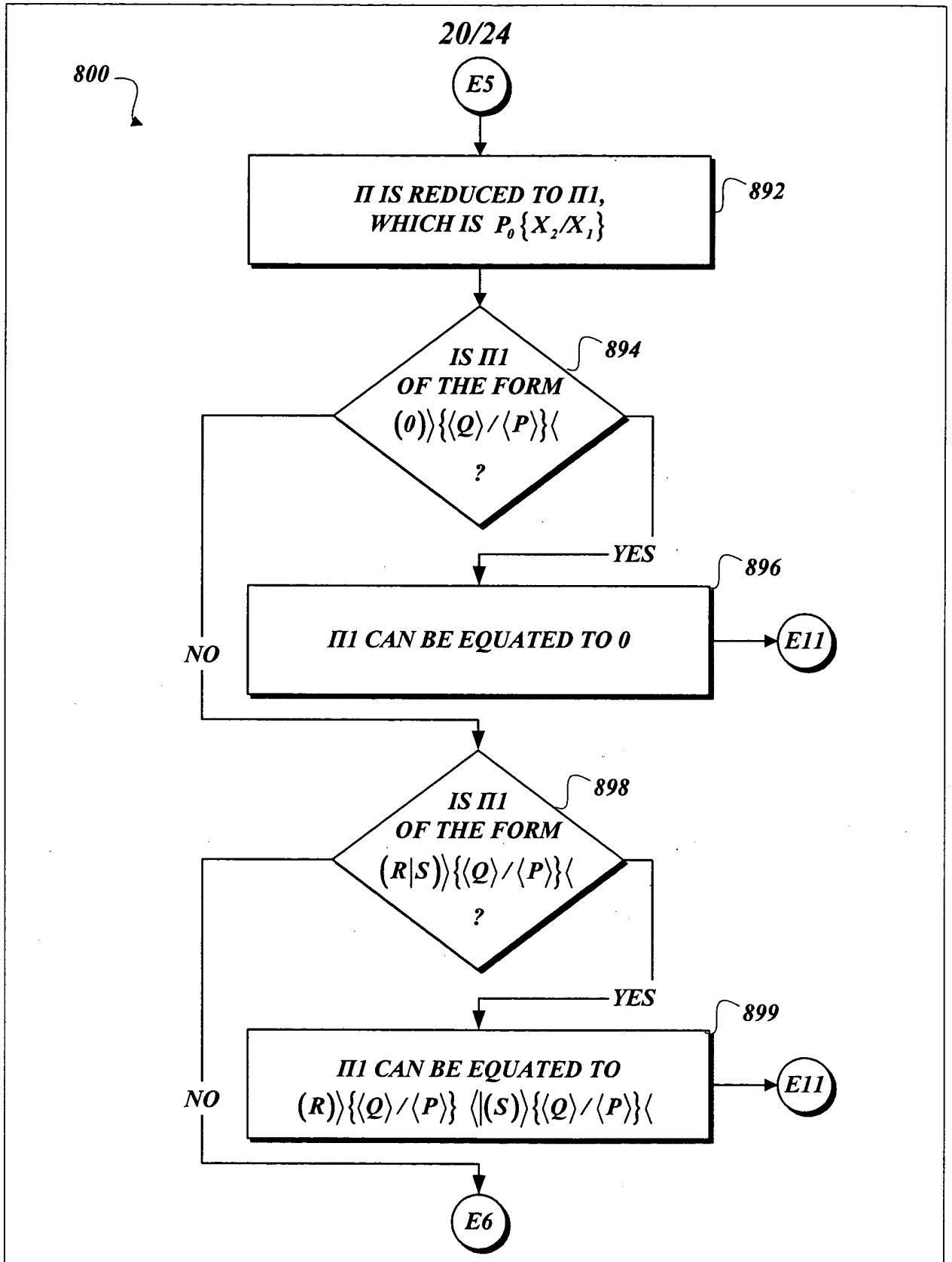

800
E5
Π IS REDUCED TO Π1, WHICH IS $P_0\{X_2/X_1\}$
892
IS Π1 OF THE FORM $(0)\rangle\{\langle Q\rangle/\langle P\rangle\}\langle$?
894
YES
896
Π1 CAN BE EQUATED TO 0
E11
NO
IS Π1 OF THE FORM $(R|S)\rangle\{\langle Q\rangle/\langle P\rangle\}\langle$?
898
YES
899
Π1 CAN BE EQUATED TO $(R)\rangle\{\langle Q\rangle/\langle P\rangle\}\ \langle|(S)\rangle\{\langle Q\rangle/\langle P\rangle\}\langle$
E11
NO
E6

Fig.8M.

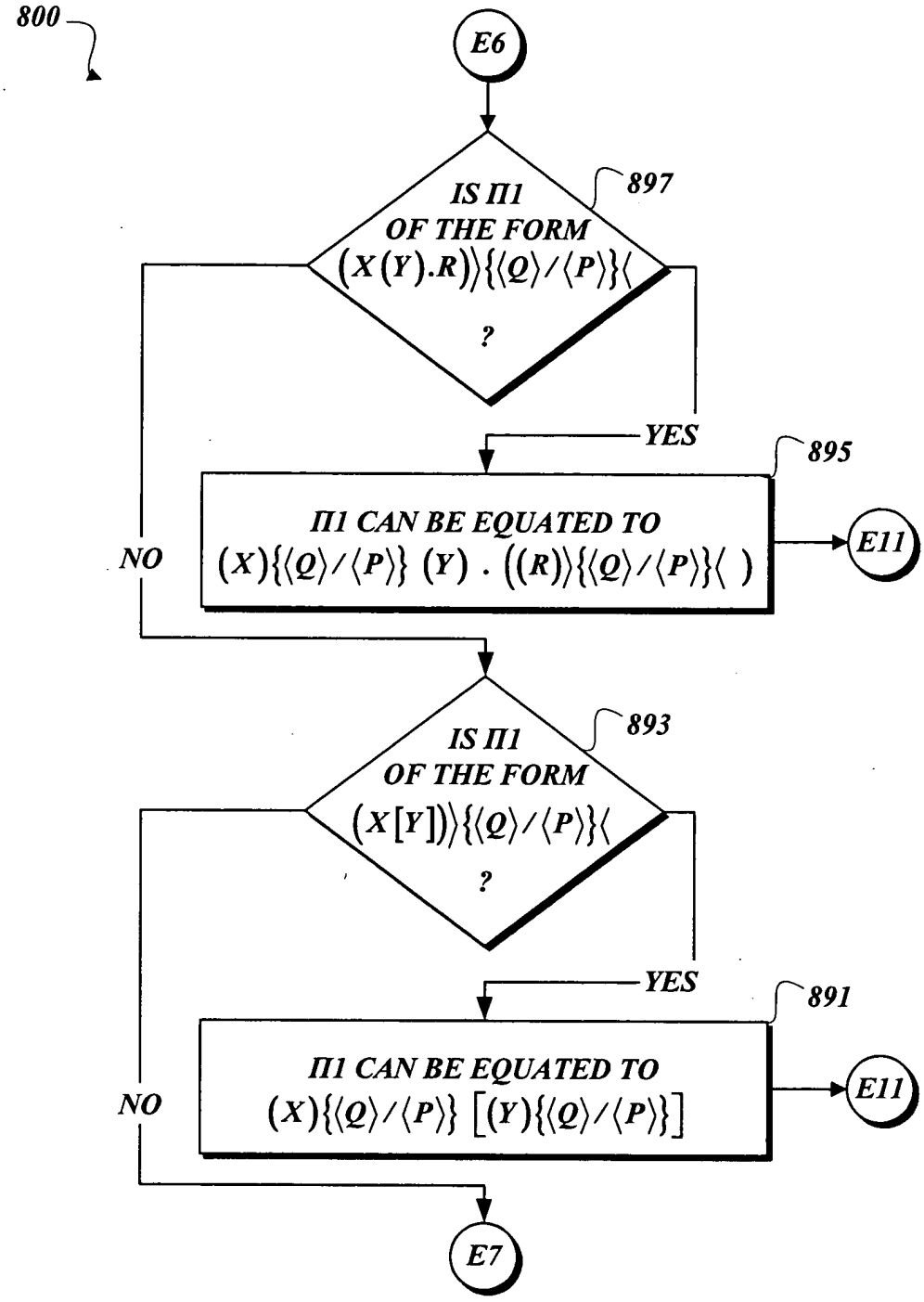

800
E6
IS Π1
OF THE FORM
(X(Y).R)}{⟨Q⟩/⟨P⟩}⟨
?
897
YES
895
Π1 CAN BE EQUATED TO
(X){⟨Q⟩/⟨P⟩} (Y) . ((R)}{⟨Q⟩/⟨P⟩}⟨)
E11
NO
IS Π1
OF THE FORM
(X[Y])}{⟨Q⟩/⟨P⟩}⟨
?
893
YES
891
Π1 CAN BE EQUATED TO
(X){⟨Q⟩/⟨P⟩} [(Y){⟨Q⟩/⟨P⟩}]
E11
NO
E7

Fig.8N.

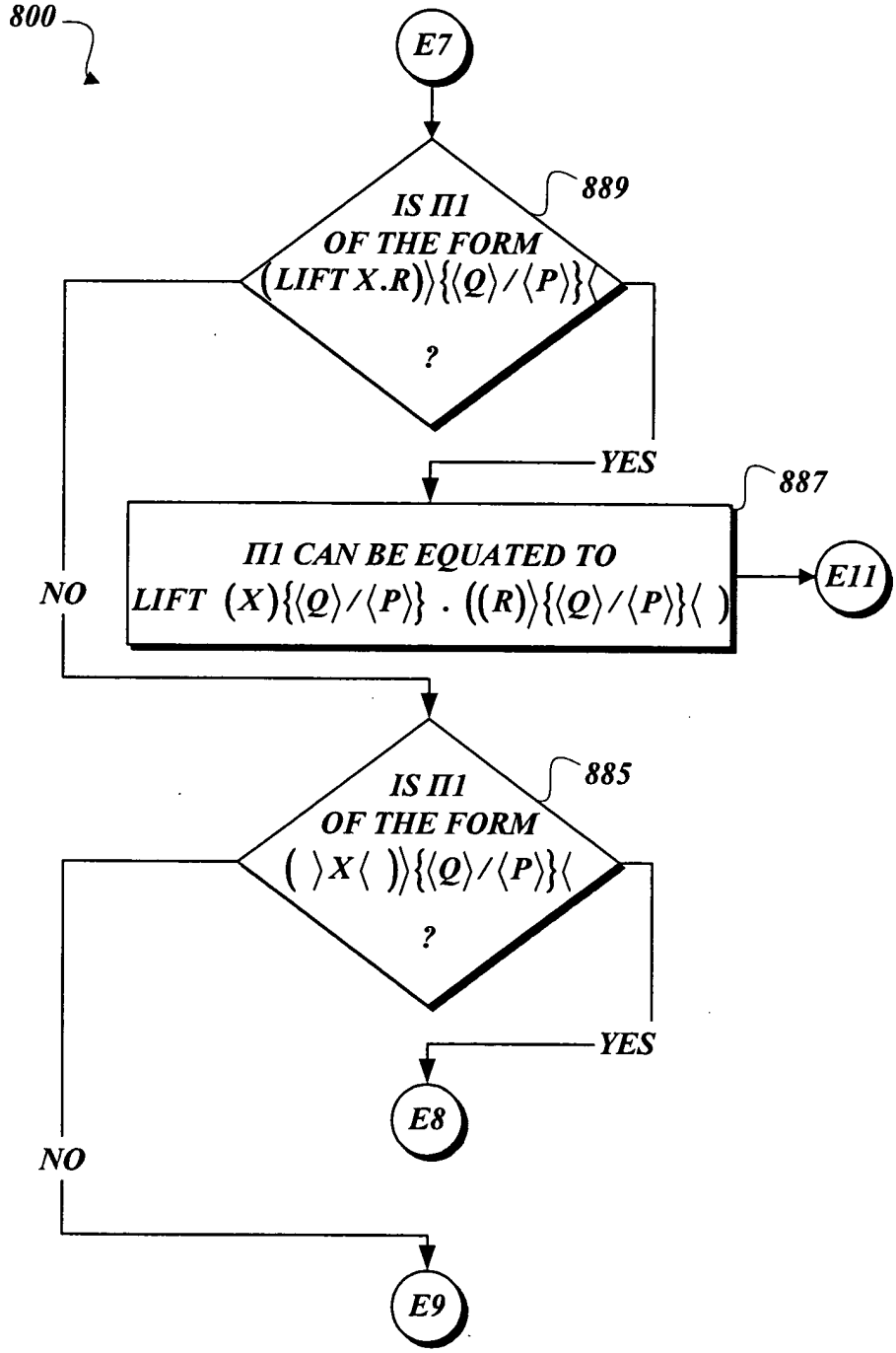
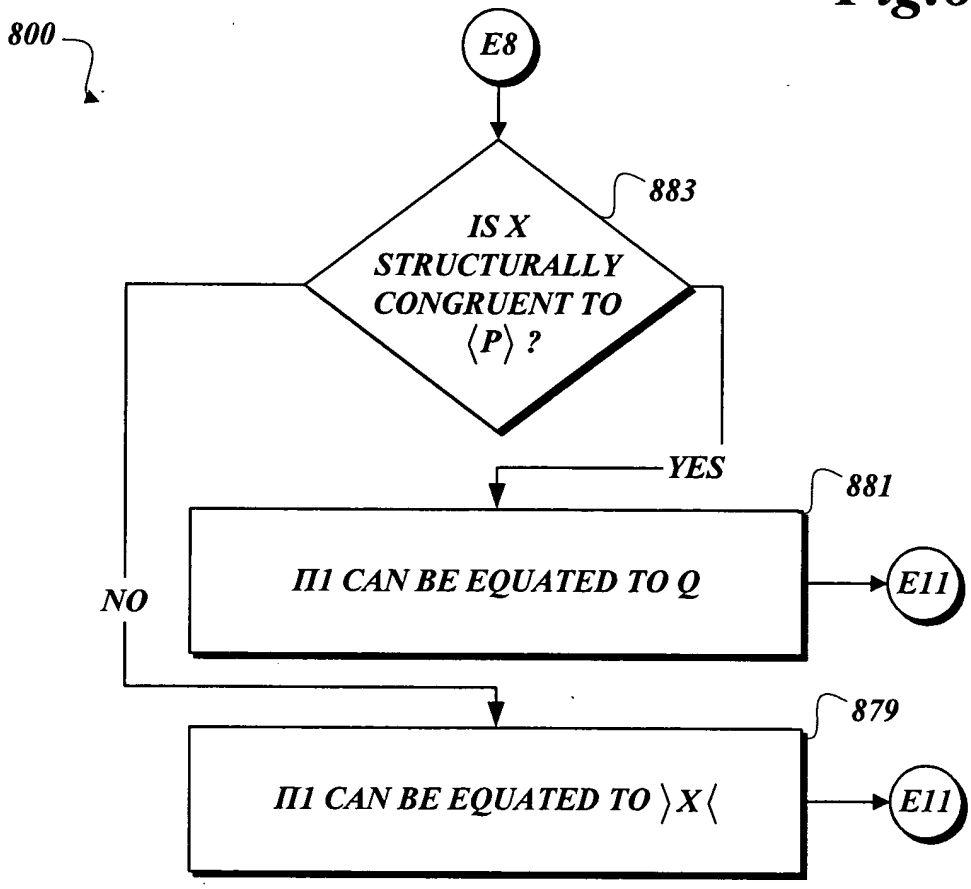

800
E7
889
IS Π1
OF THE FORM
(LIFT X.R)⟩{⟨Q⟩/⟨P⟩}⟨
?
YES
887
Π1 CAN BE EQUATED TO
LIFT (X){⟨Q⟩/⟨P⟩} . ((R)⟩{⟨Q⟩/⟨P⟩}⟨)
E11
NO
885
IS Π1
OF THE FORM
( )⟩X⟨( )⟩{⟨Q⟩/⟨P⟩}⟨
?
YES
E8
NO
E9

Fig.8O.

Fig.8P.


800
E8
883
IS X STRUCTURALLY CONGRUENT TO ⟨P⟩ ?
YES
881
Π1 CAN BE EQUATED TO Q
E11
NO
879
Π1 CAN BE EQUATED TO ⟩X⟨
E11

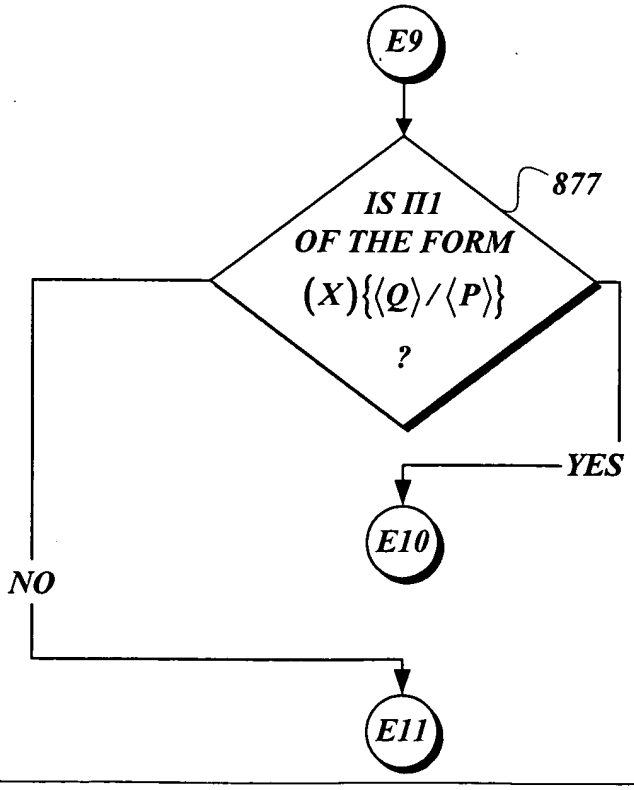

E9
877
IS Π1 OF THE FORM (X){⟨Q⟩/⟨P⟩} ?
YES
E10
NO
E11

Fig.8Q.

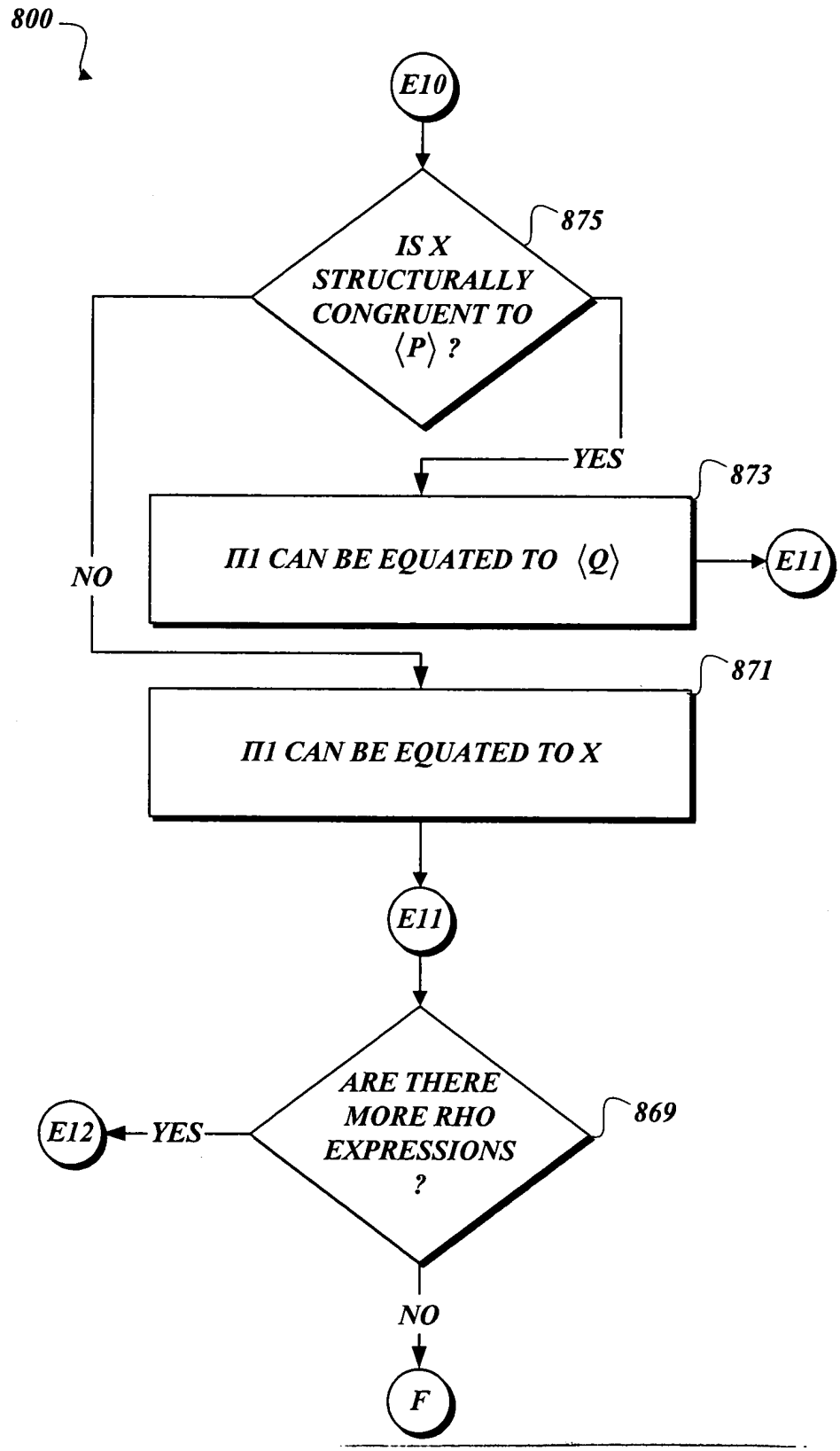

800
E10
875
IS X STRUCTURALLY CONGRUENT TO ⟨P⟩ ?
YES
873
Π1 CAN BE EQUATED TO ⟨Q⟩
E11
NO
871
Π1 CAN BE EQUATED TO X
E11
ARE THERE MORE RHO EXPRESSIONS ?
869
E12
YES
NO
F

Fig.8R.